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CRA EXPLORATION PTY. LIMITED
A.C.N.: 000 057 125

ZEEHAN No. 2 EL 34/88. REPORT ON EXPLORATION IN RELINQUISHED AREAS FOR THE PERIOD 9/12/88 TO 9/11/93.

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LICENCE HOLDER: CRA EXPLORATION PTY. LIMITED

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1. SUMMARY

CRA Exploration Pty. Limited (CRAE) is exploring the Zeehan area for a range of commodities in various stratigraphic/structural settings. Valid targets include stratiform-stratabound Zn-Pb shale-hosted deposits in the Proterozoic Oonah Formation, carbonate-hosted deposits in the Ordovician Gordon Limestone, Ni-Cr-PGE mineralisation in ultramafic bodies, and skarn-type Zn-Pb deposits peripheral to the Heemskirk Granite.

In line with statutory requirements for 50% relinquishment after five years, EL34/88 will be reduced from 68 sqkm to 34 sqkm on 9/12/93.

Proposed areas for relinquishment cover the following lithologies currently considered less prospective:-

- Devonian sediments
- Cambrian and Ordovician conglomerate, sandstone and siltstone

The only work by CRAE on the relinquished areas has been a review of existing published and open-file literature to identify exploration opportunities suitable to CRAE's objectives. No targets were identified and no field work in the areas to be relinquished has been completed.

No additional exploration by CRAE is presently warranted in the areas marked for relinquishment.

2. INTRODUCTION

EL34/88 was granted to "His Grace, The Most Noble, The Duke of Avram" on 9th December 1988, and transferred to Major Mining Ltd on the 23rd November 1989. CRA Exploration Pty. Limited entered into a joint venture agreement with Major to explore EL34/88, commencing on 23rd April 1991. At the time of writing, Major Mining Ltd was in the process of divesting its interest in the joint venture to Allegiance Mining NL, with the exploration tenements being transferred to CRAE (90%) and Allegiance (10%) as tenants in common.

EL34/88 originally covered 68 sqkm located near Zeehan on the Tasmanian W coast (Plan Tv431). On 9/12/93 this will be reduced to 34 sqkm in line with statutory requirements for 50% relinquishment after five years (Plan Tv---). This report details all exploration activities conducted within the relinquished portions of EL34/88 by CRAE between 9/12/88 and 9/11/93.

CRAE's principal commodity of interest in the Zeehan area is Zn. The Zeehan area shows some similarities with the Lawn Hill area of NW Qld, where the Century Zn-Pb discovery is situated. On this basis, CRAE believes EL34/88 holds potential for discovery of a stratabound shale-hosted Zn-Pb deposit.

Ordovician Gordon Limestone is prospective for carbonate-hosted Zn-Pb. Ultramafic bodies in the area may potentially host Ni-Cr-PGE mineralisation. Other mineralisation styles and commodities are also valid targets.

3. CONCLUSIONS

Proposed areas for relinquishment cover the following lithologies currently considered less prospective:-

- Devonian sediments
- Cambrian and Ordovician conglomerate, sandstone and siltstone

The only work by CRAE on the relinquished areas has been a review of existing published and open-file literature to identify exploration opportunities suitable to CRAE's objectives. No targets were identified and no field work in the areas to be relinquished has been completed.

4. RECOMMENDATIONS

No additional exploration is proposed for the areas marked for relinquishment. It is recommended that the tenement be reduced from 68 sqkm to 34 sqkm in line with statutory requirements.

5. REGIONAL GEOLOGY

Zeehan and it's surrounding districts have seen almost continuous sedimentation, igneous activity and deformation from the Late Proterozoic to the Quaternary. Consequently the picture of geological evolution is a complex one. Recent mapping by the Tas Dept of Mines is helping to solve old puzzles, but also continues to open new cans of worms. Corbett (1989) gives a good summary of possible tectonic models to account for the early palaeozoic geology of NW Tasmania. Some interesting new concepts are summarised informally in Turner (1992). Regional geology is summarised on Plan Tv628.

The Rocky Cape Association forms basement in NW Tasmania. This association is not represented on the Zeehan 1:63360 sheet. In the late Precambrian, around 700Ma, a shallow basin was forming in the stretched intracratonic area between the Rocky Cape and Tyennan Regions. Coarse clastic sediments (conglomerates and sandstones) of the Forest Conglomerate, Donaldson Fm and base of the Timbs Gp were deposited.

Turbidite sequences of interbedded sands and silts of upper Donaldson Fm, Timbs Gp and Oonah Fm were laid down as the intracratonic basin deepened.

As the rift phase drew to a close, sag phase Black River Dolomite, Savage Dolomite, ?Timbs Gp magnesite horizons, and Success Creek Gp limestones were deposited. Rift tholeiites and associated sediments of the Smithton Volcanics, Bernafai Volcanics, Timbs Gp and Crimson Creek Fm erupted over the now filled basin.

During the mid to late Cambrian, an arc-continent collision caused overthrusting of ultramafic-mafic rocks and related sediments, possibly from a subduction complex some distance E of the Tyennan Block. The gabbros and basalts between Trial Harbour and Zeehan are of Boninitic composition - present understandings of basalt chemistry require that these Boninites derive from a fore-arc wedge (Brown and Jenner, 1989).

Post-collision extension tectonics then produced troughs into which the Dundas Gp sediments and Mount Read Volcanics were deposited. A local metamorphic event dated at 500Ma (Penguin Orogeny), possibly contemporaneous with eruption of the MRV, affected the rift sediments in the area of the present-day Arthur Lineament. This event probably affected the formations over a broader area than seen today.

Latest Cambrian to Ordovician times saw tectonic uplift of the Tyennan Block. Rapid stripping of this nucleus produced the coarse clastics of the Owen Conglomerate and correlates. As the rate of erosion slowed, sequences became finer (e.g. Moina Sandstone). Finally, in a short period of quiessence, limestones of the Gordon Group were deposited.

A second phase of uplift introduced sands and silts into a shallow marine environment to form the Eldon Group. This event took place from the early Silurian until the early Devonian, when the first rumblings of the Tabberabberan Orogeny were being felt.

Earliest of events forming part of the Tabberabberan Orogeny was a period of thrusting, possibly induced by compressive stresses caused by the rising plutons of the Heemskirk, Meredith and Housetop Granites.

To the NW of the granites, this compression thrust imbricate slices of the Timbs Gp over one another to produce the rapid, apparently quantum jumps in metamorphic grade seen in the Arthur Lineament. To the S, the Tenth Legion Thrust within the EL area is the clearest evidence of the early Devonian thrust event (Findlay and Brown, 1992). Other thrusts are likely to have developed, perhaps along the Little Henty and Firewood Siding Faults, to "poke the tongue" of Zeehan area geology southward into the Henty Basin.

Continued Tabberabberan deformation folded the Zeehan Basin formations about NNW-trending axes.

Geological events subsequent to the Tabberabberan Orogeny do not capture the imagination of mineral explorers. Terrestrial sedimentation continued in the Permian. Jurassic dolerite sills intruded the Zeehan area. Tertiary basalts flooded much of NW Tasmania, with remnants preserved near Granville Harbour.

Tertiary and Quaternary erosion and deposition continue to modify the ancient landsurface.

6. MINERALISATION

Several periods, styles and commodities of mineralisation are recognised in the Zeehan area. In summary these are:-

PERIOD	STYLE	EXAMPLE
Proterozoic	Stratiform syn-depositional pyrite in black shale.	Oonah Fm
Cambrian	Stratiform? magmatic Ni-sulphides in ultramafics	Cuni
Ordovician	Stratabound sphalerite-galena in limestone.	Oceana
Devonian	Stratabound replacement cassiterite-pyrrhotite in carbonates	Renison Bell
Devonian	Discordant lode-style pyrite-galena-sphalerite	Spray, Comstock
Devonian	Discordant vein-style pyrite-galena-sphalerite	Comet
Devonian	Skarn magnetite (+sphalerite-cassiterite)	Saint Dizier
Devonian	Skarn pyrrhotite (+sphalerite-galena)	Sylvester

Historically it has been the lode and vein-style Pb-Ag mineralisation of the Zeehan and Dundas fields that have dominated interest. Lode-style mineralisation at Zeehan is usually hosted within graphitic shears in Oonah or Crimson Creek Fms. These deposits are high grade, but narrow (typically 0.3m) and with short strike and depth extent (usually less than 100m). In the context of modern large-scale mining practises, it is unlikely that such a target could be of economic interest on its own.

In the last 20 years or so, replacement-style Sn deposits have been given considerable attention. West Tasmania is well endowed with these deposits, which include Renison Bell, Queen Hill, Mt Bischoff and Cleveland. At Renison Bell, most ore occurs as massive pyrrhotite replacement of carbonate horizons, although a substantial quantity of ore occurs within the Federal-Bassett feeder zone. Source of the mineralisation is believed to be from Sn-rich fluids emanating from the underlying Devonian granite. A pre-mining resource is estimated at 42Mt @ 1.1% Sn (Collins, 1989).

Queen Hill is similar in style to Renison Bell, with a resource of 4Mt @1% Sn. Given the world oversupply of Sn, and the inherent low grade and metallurgical difficulties of these deposits, a replacement style Sn deposit is probably not a valid exploration target for a company without an existing Sn portfolio.

Magnetite skarn deposits such as Saint Dizier and Tenth legion have formed in carbonate lithologies adjacent to the Heemskirk Granite. St Dizier contains 5Mt @ 0.5% Sn, whilst the skarn at Tenth Legion contains low percent levels of Zn as sphalerite.

Zinc mineralisation in a pyrrhotite-serpentine skarn within Oonah Fm carbonates was discovered by RGC at Sylvester prospect, W of Zeehan in 1992. Resources are estimated to be 6Mt @ 5.5% Zn, 3.3% Pb and 40ppm Ag, The sphalerite is reported to be very high in Fe (around 18% Fe) which substantially lowers the quality of this style of mineralisation.

Nickel mineralisation as magmatic segregations within the ultramafics appears to be insignificant in quantity, although the grade of individual occurrences sounds impressive. Deposits are generally less than 50m long and of the order of 1m wide, with several percent of Ni and Cu (Blissett, 1962). Although some drilling has been carried out, there is no clear understanding of the geometry of the deposits with depth. This style of mineralisation should be considered incompletely explored.

Stratabound Pb-Zn in limestone is exemplified by the Oceana deposit where Amoco outlined a resource of 4Mt @ 19.4% Pb, 4% Zn and 106 ppm Ag (Taylor and Mathison, 1990). Mineralisation is described as syndiagenetic replacement, broadly equivalent to Irish-type deposits. Indications of other stratabound carbonate-hosted Pb-Zn mineralisation is recorded in Amoco-EZ diamond drilling from Myrtle and Grieves prospects. Despite intensive but fruitless exploration by Amoco-EZ, the Gordon Limestone still holds potential for base-metal discoveries.

Stratiform syngenetic sulphides in Proterozoic black shale was CRAE's principal focus in the Zeehan area prior to 1993. To date, no economic occurrences of base-metals in this deposit type are known in Tasmania. Gross similarities can be drawn between Zeehan and the Mt Isa and Lawn Hill areas, and on that basis some potential exists for discovery of another Century-type deposit.

The best reference for brief descriptions of all deposits of the Zeehan field, although somewhat dated now, is Blissett (1962). Early Geological Survey bulletins from between 1890 and 1910 are important historical references. A new 1:50000 geological map of the Zeehan quadrangle is soon to be published.

7. PREVIOUS EXPLORATION BY COMPETITORS

Relevant exploration activities by competitors prior to the granting of EL34/88 are summarised in Summons (1991) and Kratochvil (1991), the relevant sections appended (Appendix 1,2). Of particular significance to CRAE's activities is the exploration program on EL4/78 by Amoco, followed by EZ in joint venture, best summarised by Mathison and Taylor (1987).

During the period 1978-1987, Amoco-EZ, collected a large body of data over the Gordon Limestone as part of their Zn-Pb exploration activities on EL4/78. Amoco-EZ focussed on an Irish-type exploration model, based on their success in delineating the sub-economic Oceana deposit. Data amassed by the joint venture includes:-

- geological mapping
- wacker geochemistry
- ground magnetics
- gravity
- IP and EM surveys
- drilling logs and assays

Although the program was unsuccessful in delineating a bedrock carbonate-hosted resource (apart from the sub-economic Oceana deposit), numerous drill-holes intercepted sub-economic and patchy Zn-Pb mineralisation.

8. EXPLORATION BY MAJOR MINING LTD / CRAE FOR THE PERIOD 9/12/88 TO 9/11/93

CRAE's principal commodity of interest in the Zeehan area is Zn. The Zeehan area shows similarities with the Lawn Hill area of NW Qld, where the Century and Walford's Creek Zn-Pb discoveries are situated. Common characteristics include the presence of Proterozoic sulphidic black shales and numerous discordant (remobilised?) Zn-Pb occurrences. CRAE believes EL34/88 may hold potential for discovery of a stratiform shale-hosted Zn-Pb deposit.

Ordovician Gordon Limestone is prospective for carbonate-hosted Zn-Pb. Ultramafic bodies in the area may potentially host Ni-Cr-PGE mineralisation. Other mineralisation styles and commodities (e.g. Sn) are also valid targets.

Work completed by CRAE in the relinquished areas is summarised below.

Year 1,
Year 2: No activities were reportedly undertaken in the areas to be relinquished by Major Mining Ltd prior to CRAE's involvement in the joint venture.

Year 3: Exploration by CRAE on EL34/88 prior to 9/11/91 focussed on a compilation and review of existing open-file data (Kratochvil, 1991). Areas reviewed are retained under tenement by the joint venture.

Year 4: No activities were undertaken in the areas to be relinquished.

Year 5: No activities were undertaken in the areas to be relinquished.

Proposed areas for relinquishment cover the following lithologies currently considered less prospective:-

- Devonian sediments
- Cambrian and Ordovician conglomerate, sandstone and siltstone

It is consequently recommended that these low-priority areas be relinquished from EL34/88.

9. ENVIRONMENT AND REHABILITATION

No field exploration activities have been conducted in areas to be relinquished. Consequently there has been no impact on the environment and no rehabilitation is required.

REFERENCES

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Brown, A.V. and Jenna, G.A.	1989	Geological setting, petrology and geochemistry of Cambrian boninite and low-Ti thloeiite lavas in western Tasmania. *in* CRAWFORD A.J. (ed), *Boninites and related rocks.* Unwin Hyman, London.
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Corbett, K.D.	1989	Early Palaeozoic deformation and tectonics - Tectonic models. *in* BURRETT C.F. and MARTIN E.L (eds), Geology and mineral resources of Tasmania. *Geol. Soc. Aust. Spec. Publ.* 15, pp175-181.
Findlay, R.H. and Brown, A.V.	1992	The tenth legion thrust, Zeehan district: Distribution, interpretation and regional and economic significance. *Rep. Div Mines Miner. Resour. Tasm.* 1992/02.
Kratochvil, M.	1991	EL34/88 Henty, Tasmania. Statutory progress report for the period ending 9th November 1991. *CRAE Report No.* 17635.

Summons, T.G.	1991	EL28/88 Zeehan, Tasmania. Statutary progress report for the period ending 9th November 1991. *CRAE Report No.* 17636.
Taylor, S. and Mathison, I.J.	1990	Oceana Lead-Zinc-Silver deposit. *in* HUGHES F.E. (ed), Geology of the mineral deposits of Australia and Papua New Guinea. *Aust. Inst. Min. Metall. Monograph* 14, pp1253-1256.
Turner, N.J. (ed)	1992	Corinna 1:50000 geological map. Field guide to selected rock exposures. *Rep. Div Mines Miner. Resour. Tasm.* 1992/06.

KEYWORDS

Tasmania, Proterozoic, Ordovician, Oonah formation, Gordon Limestone, Literature review, Zinc, Lead.

LOCATION

Queenstown	SK55-5	1:250000
Pieman	7914	1:100000
Zeehan	7914-S	1:50000

LIST OF PLANS

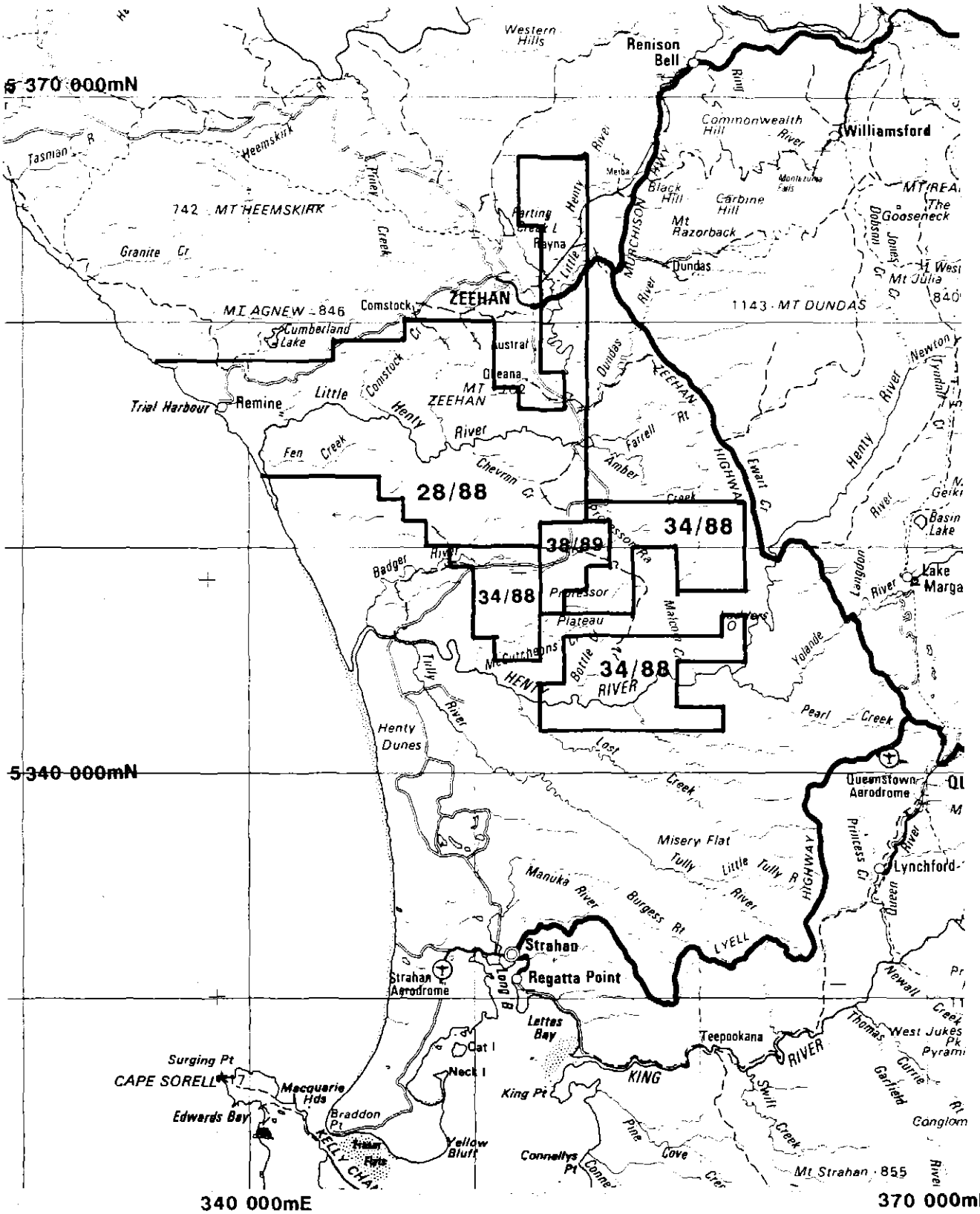
Plan no.	Title	Scale
Tv 431	Zeehan Area West Tas Zeehan Joint Venture Tenement Plan	1:10,000
Tv 630	Zeehan No. 2 EL 34/88 Recommendation for Partial Relinquishment 129km^2 to 34km^2	1:100,000
Tv 628	Zeehan Project - Regional Geology	1:100,000

LIST OF APPENDICES

Appendix 1: Summons 1991: Summary of previous exploration in the Zeehan area

Appendix 2: Kratochvil 1991: Memo from F.R. Funnell

954012



5 cm

0 5 10 15

kilometres

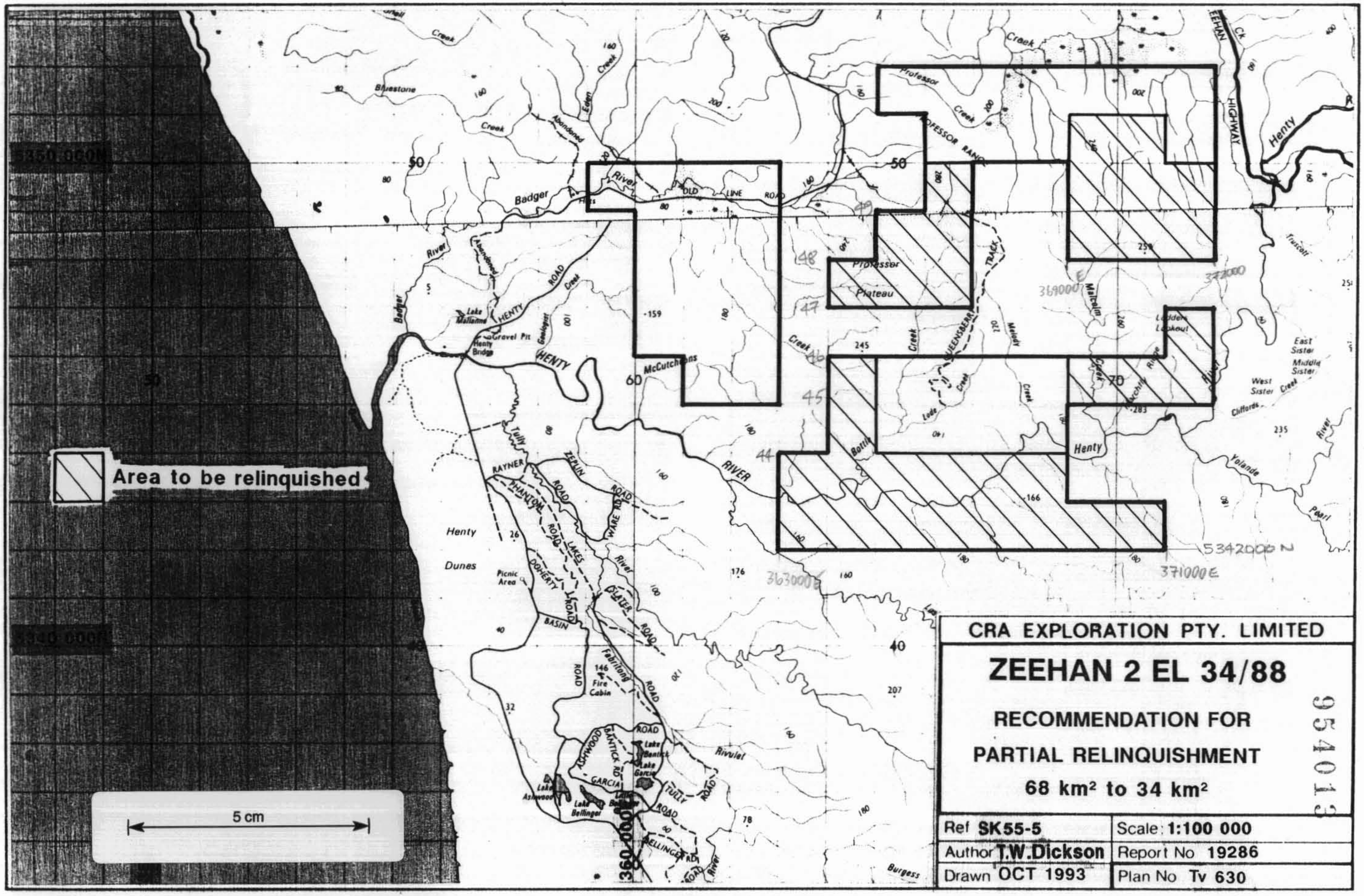
Nov.1991

CRA EXPLORATION PTY. LIMITED

ZEEHAN JOINT VENTURES

LOCALITY DIAGRAM

Ref.: SK 55 - 5	Scale: 1:250 000
Author: T. Summons	Report No.: 19286
Drawn: R. Travierso	Plan No.: TV 431



CRA EXPLORATION PTY. LIMITED

ZEEHAN 2 EL 34/88

RECOMMENDATION FOR PARTIAL RELINQUISHMENT

68 km² to 34 km²

Ref **SK55-5**	Scale: **1:100 000**
Author **T.W.Dickson**	Report No **19286**
Drawn **OCT 1993**	Plan No **Tv 630**

954013

T-Q Tertiary, Quaternary

P-J Permo-Carboniferous beds and Jurassic dolerite

+ + Devonian granite

S-D Siluro-Devonian Eldon Group

Ogl Ordovician Gordon Gp Limestone

Upper Cambrian-Lower Ordovician Owen Conglomerate and correlates

Middle - Upper Cambrian Dundas Gp

Quartzwacke sequence at Farrell Rivulet

Mafic volcanics

Ultramafic-mafic complexes & gabbros

Crimson Creek Formation

Success Creek Group

Precambrian

0 5 Km

5 cm

Lake Pieman

S-D

Ogl

RENISON BELL

Colebrook Hill

5370

Serpentine Hill

CUNI

ROSEBERY FAULT

Moores Pimple

DUNDAS

ZEEHAN

Misery Hill

Mt Dundas

5360

P-J

McIvor Hill

LITTLE HENTY FAULT

FIREWOOD SIDING FAULT

Professor Range

HENTY BRIDGE

STH HENTY FAULT

5350

Q

The Sisters

Henty R.

SOUTHERN OCEAN

WESTERN SEQUENCE

350

360

370

CRA EXPLORATION PTY. LIMITED

ZEEHAN PROJECT

REGIONAL GEOLOGY

Ref.: SK55-5	Scale: 1:100 000
Author: RGP	Report No.: 19286
Drawn: RGP	Plan No.: Tv628

93-35522

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APPENDIX 1:

SUMMONS 1991: SUMMARY OF PREVIOUS EXPLORATION IN THE ZEEHAN AREA

APPENDIX 1.

from Summons 1991.

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3. HISTORY OF EXPLORATION AND MINING

3.1. Early Exploration & Mining

The Zeehan mineral field was known in the early prospecting days of the 1870's for its tin content, but quickly changed to a silver-lead mining field with the discovery of argentiferous galena in 1882.

The field was progressively developed until 1898, following which production declined steadily until 1910 when most of the mines had closed due to the depletion of shallow ore; closure of the local smelter in 1913 was a precursor to the cessation of significant mining activity in 1919.

Exploitation of some 200 lodes (averaging 0.3m * 100m * 100m) resulted in the production of 200,000 tonnes of Pb, and 27 M ounces of Ag (Both et al 1969). Most of the production occurred in the period up to 1919, of which the majority (90%) came from lodes hosted by Proterozoic and Cambrian age rocks; around 55% of the Pb production and 60% of the Ag production was derived from 4 deposits (Montana No 1, Western, Queen & Oonah).

3.2. Systematic Exploration

Sundry prospecting activities occurred between 1919 and 1946 (eg tribute mining from the Nike and Swansea mines), when the current phase of systematic exploration (including a brief period of mining from the Oceana), began;

1946 - 1960 Zeehan Explorations P/L
Zeehan Explorations P/L (joint venture between North Broken Hill & Broken Hill South), did ground surveys to check the continuity of the Spray - Nubeena shear zone (including unsuccessful drilling at the Spray mine), and initiated the BMR managed magnetic, gravity and electrical (SP, EM) surveys.

These surveys were generally unsuccessful, viz - some of the gravity anomalies were due to concentrations of siderite, and the electrical surveys failed to give responses over known mineralization.

However, drilling around the Oceana mine proved encouraging, and after some rehabilitation work (including the sinking of a new shaft), the mine was reopened and went on to produce 129,000 tons of ore grading 11.6% Pb and 4.79 oz Ag /ton in the period 1954 - 1960.

1966 - 1970 Placer Prospecting P/L
Placer also focussed on the Spray - Nubeena shear zone, including soil sampling and a TURAM EM survey over the main Spray lode; Minops P/L farmed in to the property and drilled several holes in to the same lode, but achieved disappointing

results - 0.0025m of galena was interpreted as the Spray main lode between the 5 and 6 levels.

1970 - 1972 Tenneco P/L

Teneco dewatered, sampled and further drilled around the Spray mine; the cored hole cut a jamesonite lode (0.2m @ 16.8% Pb, 0.08% Zn, 6.8% Sb, 1.4% Cu and 267 oz Ag/ton), and further on the main lode from which only pyrite was recovered at a point 85 m below no 6 level. As Zeehan Explorations had earlier drilled a jamesonite quartz vein, a further 4 holes were dilled from no 5 level to test the extent of this lode, but failed to locate any significant mineralization.

In addition they conducted a TURAIR airborne EM survey of most of the Gordon Limestone area. Follow-up gravity, TURAM ground EM and SP surveys produced mixed results; thr ground EM survey detected several anomalies, including the Spray no 1 load, the Foam/Wave and Nubeena deposits, and probably graphitic shales. The SP survey failed to locate any significant anomalies close to Zeehan, and the EM anomalies recognized in the Grieve Valley south of Zeehan were found to be due to conductive overburden.

1974 - 1986 Mt Lyell Mining & Railway Coy (SPL 129)
Renison Ltd (EL 11/76)

1974 -75: The Barringer - Input airborne EM system was trialled by Geoterrex on several northerly trending lines between the Swansea and the Comstock mines. Strongly conductive anomalies with associated magnetic anomalism were located over the North Comstock, Comstock, Boss, Susannite and Britannia desposits.

1980 - 1981: The geological mapping showed the dolomites in the Oonah Formation to be more common than previously recognised, and the presence of a spilite-pyrite association (the pyritic beds containing minor galena),in the Oonah formation. The mapping also recognized the problem in distinguishing between the Cambrian age Crimson Creek Formation and the "fossiliferous" Dundas group rocks; original unconformable contacts between Oonah Formation and Cambrian sediments/volcanics are frequently thrust faulted and/or overturned.

1981 -1982: A major airborne EM (DIGHEM) and magnetic survey was conducted over the eastern end of the tenement. The DIGHEM system was considered to be more sensitive the TURAIR EM method, and it was hoped that DIGHEM would reveal EM anomalies over blind Queen Hill style mineralization; the 1973 TURAIR survey outlined various conductors around the flanks of the Queen Hill magnetic anomaly (200 γ), and a similar pattern was obtained by the DIGHEM survey on the northern side of the Stonehenge magnetic anomaly (400γ). (The Queen Hill deposit has anomalous responses to IP, SP, applied potential and airborne EM surveys).

DIGHEM defined numerous (74) conductive anomalies, many of which were interpreted as lying along WNW trending zones regarded as indicating continuous (stratigraphic) black shale horizons. Several of these interpreted zones incorporate old workings , viz Susannite, Britannia, Comstock, South Comstock and Sunshine. None of the major WNW trending faults in the area gave a response, and the coincidence of some old workings (but not all) with conductive zones implies the pre Devonian-vein existence of such zones; (the correlation of DIGHEM with the Input EM is noteworthy - particularly for the Comstock - Britannia tract).

1982 -1983: Work in this period involved the establishment of the Stonehenge grid over the strong aeromagnetic anomaly, followed by bedrock geochemistry, ground magnetic, VLF EM and gradient array IP surveys. The VLF survey located most of the DIGHEM anomalies, and also defined several weaker zones not found by DIGHEM. The gradient array IP survey showed low resistivities over clays on the north side of the grid, as well as several chargeable zones (interpreted as due to graphite and/or pyrite in the sediments). The detailed ground magnetic survey confirmed the broad deep-seated anomaly located by the 1981 Department of Mines survey, and was interpreted by J. Bishop as due to a mafic intrusive. A single hole (TH12) is reported to have made two intersections "anomalous in base metals, As and Sb".

1983 -1984: Work during this period consisted of follow-up drilling to test the various anomalies produced by earlier work. Drill hole TH13 was collared 200m NNE of the Sunshine Mine, and was designed to test the southern extension of Spray No 3 lode; it traversed a fault channel which was weakly mineralized, viz 61m at 0.90% Pb, 0.59% Zn, 29 gAg/t.

Drill hole TH14 was collared 1 km NNE of the Tasmanian Mine in order to test a combined brecciated limonitic sandstone with a geochemical (Pb Zn Cu As W) anomoly and a strong VLF EM anomoly; the target returned 10.7m at 0.12% Pb, 0.04% Zn, 2gAg/t, and a further (deeper) intersection of 3.9m at 0.24% Pb, 0.01% Zn, 7 gAg/t was recorded in sandstone hosted quartz veins.

Drill hole TH 15 was collared 500m NNE of the Sunshine and drilled on the opposite azimuth to TH 13 to further assess the mineralization found in that hole; however, it also entered the fault zone and returned a best intersection of 24m at 0.27% Pb, 0.54% Zn, <1 gAg/t; the mineralization in both TH13 and TH15 is considered to be Devonian in age.

Drill hole Th16 was collared 200m east of the Spray main lode, with the object of testing same; the lode was not cut, apparently because a conjugate shear (Cross Chloride fault), appears to have accomodated dilational strain in this area of the Spray shear system, and thus impeded the movement of mineralizing fluids. Weakly stanniferous mineraliztion was encountered in several quartz vein stockwork zones
e.g. 1m @ 0.10% Sn, 0.03% As, 0.36% Cu, 0.01% Pb, 0.03% Zn;
1m @ 0.10% Sn, 0.40% As, 0.21% Cu, 0.16% Pb, 0.03% Zn;

1m @ 0.03% Sn, 0.50% Cu, 0.01% Pb, 0.01% Zn;
none of which were confidently interpreted as the Spray main lode.

1984 - 1986: The EM 37 survey detected a large number of anomalies many of which were correlated with black shales and/or faults. Several single line anomalies (one later tested by TH17) were seen, including one over Grubbs workings; a follow-up UTEM survey produce anomalies generally in agreement with the EM 37 survey results, including a poorly defined response over Grubbs workings. The best anomaly located was 300m NNE of Grubbs, and is coincident with a VLF anomaly; it was interpreted as a fault, but not tested.

Drill hole TH17 was collared 400m NNW of Sunshine and designed to test the combined EM - magnetic anomaly; no significant mioneralization was met, and the anomalies are apparently due to graphitic shales with variably pyritic breccia zones.

A downhole EM survey (using a SIROTEM system) was done in hole TH17, but did not locate any off hole mineralization to explain the surface Em anomalies.

1978 - 1983 Amoco

Amoco focussed their attention on the Gordon Limestone, but most of the work was done around the Oceana and Austral Pb Zn deposits via gravity, magnetics, IP, EM and bedrock geochemical surveys. Subsequent core drilling outlined a subeconomic resource at Oceana (4 M tonnes @ 19.4% Pb, 4.0% Zn, 106 gAg/t), and associated studies of this deposit showed it to be of sedimentary exhalative origin (similar to the Irish deposits exemplified by Navan and Silvermines); Pb isotope data shows the mineralization to be at least Ordovician in age.

1983 - 1987 Amoco (Cyprus Mines) - EZ Coy JV

The joint venture partners focussed their attention on other areas of Gordon Limestone to the south of Oceana, namely Pyramid, Myrtle, Grieves, Rose Valley and Baura; they conducted various EM surveys (Genie, UTEM, EM37, SIROTEM), bedrock geochemical sampling, gravity and dipole - dipole IP surveys.

Auger sample anomalies were confirmed by trench sampling but many were later shown to be spurious and due variously to transported clays, or to secondary dispersive effects about strongly depleted primary mineralization.

Core drilling of coincident geochemical-UTEM anomalies was disappointing, the UTEM responses being due to either fault zones, or to marked lithological contrasts (e.g. limestone versus black shale).

The results of a dipole-dipole IP survey of a gravity anomaly in the north Austral valley and the drill results of a EM37 anomaly near the Montagu deposit are unknown.

The EZ Coy concluded in 1987 that the Myrtle - Rose Valley area had good potential for Pb Zn mineralization on the basis of several untested geochemical anomalies, incompleted bedrock sampling, the non-conductive nature of the target mineralization, and the low density of drill holes on the various grids.

APPENDIX 2:

KRATOCHVIL 1991: MEMO FROM F.R. FUNNELL

APPENDIX 2.

954022

DATE: 19th July 1991

MEMORANDUM TO: M Kratochvil

COPY: T W Dickson

FROM: F R Funnell

SUBJECT: A Summary of Exploration for Carbonate Hosted Pb-Zn conducted in the Zeehan Area (1978-1989)

SUMMARY

The Badger River Grids appear have been adequately explored. The McCleans and Fen Creek areas drain fault bounded blocks of Ordovician Limestone which have received little attention. The limestone block centred on McCleans Creek has little mapped Quaternary cover. This lack of cover makes it the most attractive of the unexplored carbonate blocks.

Lead isotope studies carried out by the CSIRO on galena samples from the Oceana Mine[1] showed the samples had a closer isotopic affinity with the lead from the Mount Reads rather than Devonian Granite related lead. This Cambrian-Ordovician age raises the possibility the metals were sourced from the Mount Reads and emplaced into the carbonates rather than the accepted (by Cyprus/EZ) theory that the metals are syndepositional/diagnetic in origin.

INITIAL RECOMMENDATIONS

1) A one to two day mapping, sampling traverse along McCleans Creek should provide sufficient information to decide whether or not further work is warranted.

2) A geophysicist examines the UTEM data from Badger River grids to determine whether all anomalies have been identified.

INTRODUCTION

This memorandum details the progress to date of a review of exploration for carbonate hosted Pb-Zn mineralization in the Zeehan area, NW Tasmania. The study area covers some 900 sq. km and blankets EL's 28/88, 34/88, 33/89 and 39/89. (Figure 1). Given the limited time available (5 days) and the size and complexity of the database it was only possible to commence the review.

Exploration Licence 4/78 was applied for by Amoco in the late seventies and subsequently held and explored by Cyprus and EZ and covered most of the current study area. The EL was subject to a substantive exploration programme whose primary target was Irish type carbonate hosted Pb-Zn deposits within the Ordovician Gordon Limestone. Cambrian hosted tin and basemetal mineralization were secondary targets. The exploration data from EL 4/78 is the most reliable available for the study area and consequently this review has focused on this data.

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[1]By 1983 Amoco had outlined a resource of 4,000,000t @ 2% Pb and 8% Zn and 80g/t Ag on the basis of 13 drillholes.

EXPLORATION

954023

Overview:

North Broken Hill and Broken Hill South explored the area around the Oceana Mine between 1946 and 1951. As a result of this work the mine was reopened in 1954 and operated until falling grades and rising dewatering costs (11 million litres/day) forced its closure in 1960. A limited heliborne Turair survey was flown by Tennenco around 1970. This was followed up by reconnaissance IP, SP and soil sampling.

Amoco commenced work on EL 4/78 in 1978. Most work concentrated on the limestone block covered by the Rose Valley, Baura, Grieves and Myrtle grids (collectively known as the Badger Valley grids) and the Austral-Oceana grids . These areas were ranked highly because of the known Zn-Pb-Ag mineralization (Oceana and Grieves Mines) and excellent access via the Henty road.

A semi-regional stream sediment sampling programme was completed over selected limestone blocks. Minus 80# stream sediment and Panned Concentrate samples were collected. All samples were assayed by AAS for Au, Cu, Pb, Zn, Ag (+Cr and Ni in Pan Cons) and for Sn by XRF. Anomalies were followed up by soil and bedrock geochemistry, magnetics, gravity, ground EM and diamond drilling.

A review of exploration can be found in EZ report T229 (May 1986-May 1987). The geophysical investigations were summarised in Amoco report 353 (January-July 1983). Table 1 lists the exploration completed on EL 4/78 and the relevant report reference. The licence was relinquished in 1989.

Analytical Considerations:

The check sampling for the regional programme was inadequate. The check sampling density was insufficient (one check per 20 samples). No mention was made of any check of sample preparation (carried out by Amoco prior to despatch to Comlabs). No orientation work or duplicate sampling was recorded. As no sample site ledgers are available it is difficult to asses the quality of the sampling.

Sampling Problems:

The sampling problem occurs on the macro and meso scale.

On the macro scale the intensity of exploration is directly related to the ease of access. It is no coincidence that the most intensively explored block of limestone has the Henty road running down the middle of it. The Fen and McCleans Creek blocks (boat or helicopter access only) were not been sampled.

The meso scale problem arises from the fact the limestone has been weathered under wet, acid conditions. The Ordovician limestones tend to form flat bottomed valleys bounded by ridges of Moina Sandstone and Crotty Quartzite. The limestone is often mantled by a layer of puggy decarbonized limestone which is inturn overlain by Tertiary to Recent mud, peat, coal, sand and gravel. Cyprus and EZ used Bombardier mounted Jackro rigs, wacker sampling and excavators to collect soil samples. These techniques were necessary to penetrate the overburden (often thicker than 3m). Mathison (EZ report T192) noted that there was "poor agreement" between assay results obtained from wacker, Jackro and excavator samples. Assay values only agreed when the samples were collected from the soft, partially weathered limestone close to bedrock. Secondary dispersion of Pb and Zn in the clays appears widespread.

Geophysical Constraints:

In common with many Tasmanian programmes the geophysical exploration of EL 4/78 could have benefited from greater planning. Some test work was done on core from Oceana. The rocks were observed to be variably conductive and to possess low magnetic susceptibility.

The gravity surveys over the Badger River Grids (100m line spacing and 50m stations) were useful but the presence of a clay rich, conductive overburden and faults unrelated to mineralization significantly reduced the effectiveness of the EM systems. Over the years Turair, Genie EM, PEM, SIROTEM and UTEM systems were used over selected portions of the EL. A complication in the Badger Creek grid area is that Pb constitutes only a minor portion of the sulphide lode (zinc dominates as sphalerite or smithsonite/zincanian siderite) and copper sulphides are very rare.

The presence of fine grained disseminated sulphides in the Gordon Limestone resulted in the early IP surveys being of little use.

Cyprus-EZ Model:

The mineralization at the Oceana Mine will be used to demonstrate the Cyprus-EZ model.

South of the Mine Fault lie stratabound bodies of semimassive weakly banded sphalerite, galena and siderite which occupy the top and bottom portions of a 30m thick limestone breccia body. It has been considered to result from syndiagenetic replacement.

North of the Mine Fault coarse grained galena, sphalerite and siderite with minor quartz, calcite and trace pyrite and chalcopyrite either as discordant irregular massive lenses or as open space fillings and interclasic areas in breccias. This mineralisation is different from that found to the south in that it has higher copper content and is accompanied by pervasive dolimitization and silicification.

Mathison and Taylor (EZ report T229) argue the breccias south of the Mine Fault are the result of submarine gravity debris flows triggered by movement on the Oceana Fault during the deposition of the limestone. They also suggest that the structurally controlled base metal veins (presumably the mineralization from the N of the Mine Fault) is related to the Devonian Heemskirk granite and associated hydrothermal systems. This ignores the isotopic data (samples were collected from both styles of mineralization) which indicates that all the lead had a common character/source and was Cambrian-Ordovician in age (see attached).

The presence of "submarine debris flow" breccias in the Gordon limestone is atypical as they suggest a deep water environment. The limestone was deposited in a very shallow marine setting. The conventional model invokes substantial movement along the existing faults. While it is evident that some faults were active during deposition it is considered unlikely the movement across these faults was sufficient to accommodate the Cyprus-EZ Model.

Alternate Model:

The limestone breccias observed South of the Main Fault at Oceana and in drillcore from the Badger River Grids was hydrothermal/diagenetic in origin and directly related to the mineralizing event.

The metals were thought to have been sourced from the underlying Cambrian sequence rather than from syn-depositional precipitation.

If this interpretation is correct it shows that it is possible to remobilize substantial amounts of metals from the Cambrian into overlying sequences.

WORK	MYRTLE GRID	GRIEVES GRID	BAURA GRID	ROSE VALLEY GRID	BADGER RIVER GRID*	PYRAMID GRID	SASSAFRASS GRID	PROFESSOR GRID	REGIONAL
GEOLOGICAL									
MAPPING	6	6			4, 6				
GEOCHEMISTRY									
SOILS (HAND AUGER)	1, 2	1							SS = 12
SOIL (WACKER)	6	5, 6	5, 6		5, 6, 7	7			
BEDROCK (JACKRO)	3, 12				13, 4	4			
BEDROCK (COSTEAN)		5	5	5	5	5			
GEOPHYSICS									
MAGNETICS					13, 4, 6		?	6	13
GRAVITY	3, 6				3, 6	3	3		
EM (GENIE)		5			5				
EM (SCHOTEM)									
EM (PEM)									
EM (UTEM)		6	6		5, 7				
DRILLING									
WINKIE		6			7	7			
DEEP DIAMOND		5, 9, 11			5, 7, 8				

1. June 1978 - June 1979, Amoco Report
2. June 1979 - June 1980, Amoco Report
3. July 1981 - January 1982, Report No. 279
4. June 1983 - January 1984, EZ Report T177
5. January 1984 - June 1984, EZ Report T192
6. June 1984 0 April 1985, EZ Report T205
7. May 1985 - May 1986, EZ Report T215
8. April 1986 - April 1987, EZ Report T299
9. April 1987 - April 1988, EZ Report T232
10. May 1988 - July 1988, EZ Report T234
11. January 1989 - June 1989, EZ Report T241
12. January 1983 - July 1983, Report No. 353
13. July 1982 - December 1982, Report 347

* The Myrtle, Grieves, Baura and Rose Valley grids are collectively known as the "Badger Valley Grids"